

The Unconformity in the Kelly Belt, east Pilbara Craton

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Abstract

The approximately 3 Ga year old unconformity of the Whim Creek Group and other pre-Mt Roe Basalt sequences on older rocks, in particular on banded iron formations (BIFs) of the Gorge Creek Group, is now generally accepted, being recorded in most of the greenstone belts of the Pilbara Craton. However, recent studies indicate that it occurs only as far south and east as the Marble Bar and Coongan Belts which flank the Corunna Downs and Mt Edgar batholiths. In the Kelly Belt, to the east of these batholiths, the unit previously mapped as the Lalla Rookh Sandstone (incl. Budjan Creek Formation) equates instead to the Corboy Formation, which is at the base of the Gorge Creek Group in the East Pilbara. These clastic sediments grade up into, and form an unbroken sequence with, the BIFs of the Paddy Market (Cleaverville) Formation of the Kelly Belt. They are thus assigned to the Soansville Subgroup, which can now be used synonymously with the term Gorge Creek Group. The basal clastics are also tentatively correlated, because of similarities in the sequence, to parts at least of the Mosquito Creek Formation further to the east.

Mafic volcanics do occur elsewhere in this grouping but the choice of the type section for a basalt in the Soansville Subgroup, near Charteris Creek in the Kelly Belt, is inappropriate because there this basalt underlies the unconformity and is part of an unbroken sequence of pillowed volcanics, cherts and thin tuffaceous sediment bands, frequent in the Salgash and the Talga Talga subgroups.

Introduction

Stratigraphic subdivisions of the Marble Bar area were established by Lipple (1975) and partly revised and extended by Hickman (1983) to the whole of the northern exposed part of the Pilbara Craton. Following earlier workers such as Maitland (1908) and Noldart & Wyatt (1962), Lipple (1975) had subdivided the layered sequence into a lower, Warrawoona Group, dominantly of volcanic origin and an upper, Gorge Creek Group, essentially of sedimentary rocks. The latter was subdivided into a lower, Soansville Subgroup and an upper, unnamed part which included the Lalla Rookh Sandstone, the Bunjan Creek formation, and the Mosquito Creek Formation. Like previous authors, Lipple recorded unconformities at the base of these three formations in some localities though Hickman (1983, p. 105) considered these to be of local significance only.

Fitton *et al.* (1975), from studies in the West Pilbara between Roebourne and Wodgina, restricted the term Gorge Creek Group to what would appear to equate to Lipple's Paddy Market Formation (or the Cleaverville Formation of Ryan & Kriewaldt 1964) which is part of the Soansville Subgroup (see Table 1). This formation is characterised by the developments of thick cherts, chertified sediments, BIFs (banded iron formations), and in places shales. Fitton *et al.* recognized a hiatus and regional unconformity between this unit and the overlying sequences which they estimated (1975, figure 1) from available geochronological data to have occurred about 3 Ga

Table 1

Archaean layered succession of the Pilbara (names referred to in text). Amended after Fitton *et al.* (1975), Lipple (1975), and Hickman (1983). (Geochronology, see Blake & McNaughton 1984 and Trendall 1983).

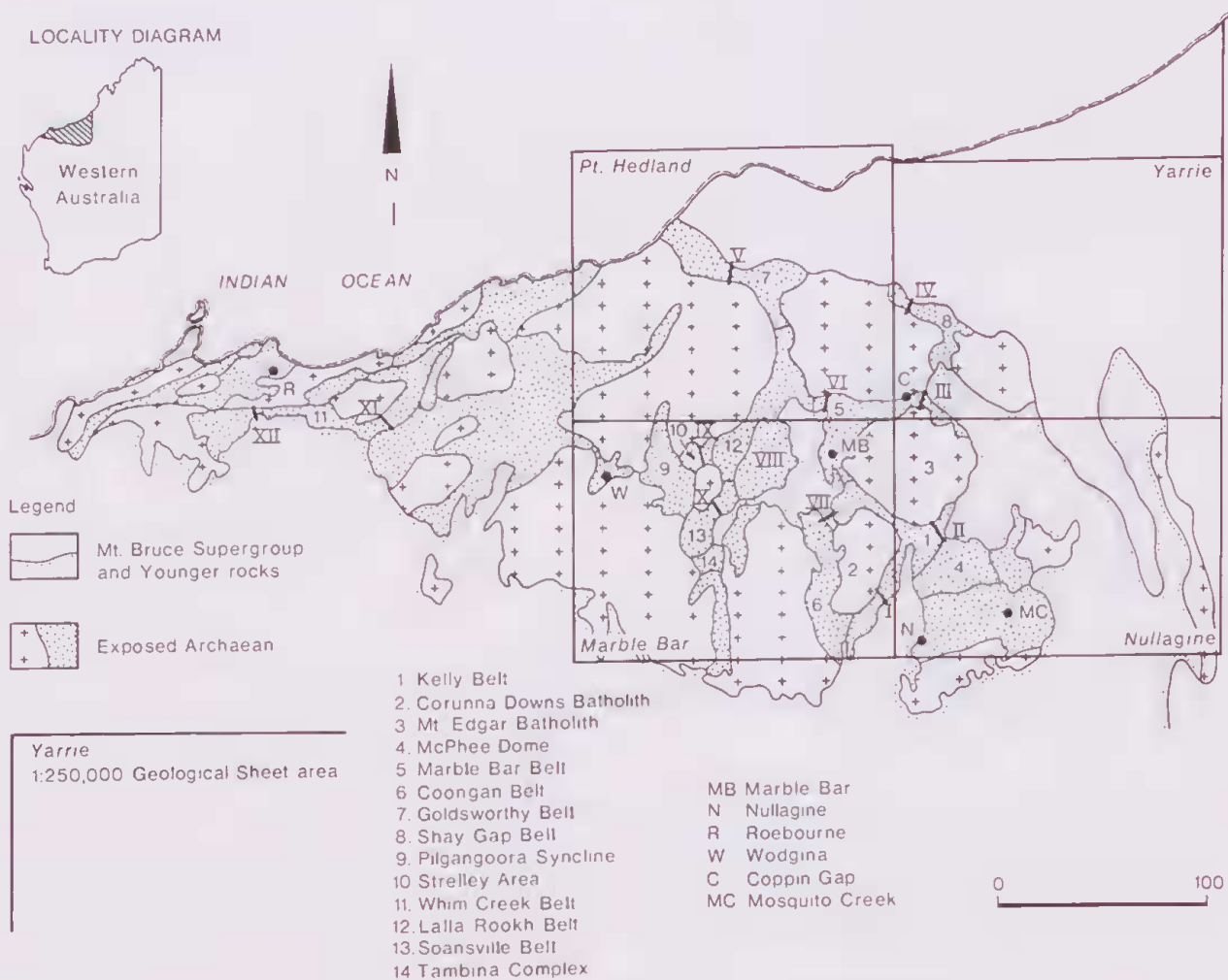
Mt Bruce Supergroup	Mt Roe Basalt
	Regional unconformity (about 2.8 Ga)
	Negri Volcanics ← (?) Basalt (Yarrie Sheet area)
	(including un-named sediments and the Loudon Volcanics) — (?) Lalla Rookh Sandstone
Whim Creek Group	Local unconformity
	Mallina Formation (includes the Rushall Slate and un-named acid volcanics)
	Constantine Formation
	Mons Cupri Volcanics
	Warrambi Basalt
Gorge Creek Group	Regional unconformity (about 3 Ga)
Soansville Subgroup	Mosquito Creek Formation
	Honeyeater Basalt (excluding units mapped on Yarrie Sheet area)
	Paddy Market (Cleaverville) Formation
	Charteris Basalt (Excluding type section area)
	Corboy (Budjan Creek) Formation
Warrawoona Group	Regional unconformity
	Salgash Subgroup
	Duffer Formation (3.4 to 3.5 Ga)
	Talga Talga Subgroup

years ago. Available geochronological results for the whole of the Pilbara Craton are now summarized by Blake & McNaughton (1984) and by Trendall (1984). Fitton *et al.* named the sequences above the hiatus, the Whim Creek Group and the Negri Volcanics. The Whim Creek Group contained a volcanic province and a clastic province. Sediments of the latter (the Constantine Sandstone and the Mallina Formation) were equated, although not always specifically by name, to the upper, un-named part of Lippie's Gorge Creek Group; the unconformity in the West Pilbara was equated to those recorded at the base of the Lalla Rookh Sandstone, the Bunjan Formation, and the Mosquito Creek Formation.

Hickman (1977: 1983, pp. 19 & 105) denied the validity of the regional hiatus and unconformity but this was however refuted by Horwitz (1979) and Horwitz & Guj (1986). Also, both Wilhelmij & Dunlop (1984) and Krapez (1984) have mapped in detail, and recorded breaks with angular relationships, basal to the Lalla Rookh Sandstone or its equivalent, in parts of the Strelley area and in the Lalla Rookh Syncline. Horwitz & Guj (1986) pointed out that this break exists throughout the

Goldsworthy and the Shay Gap belts, between what Hickman (1983) assigned to the cleaverville (Paddy market) Formation and to the Lalla Rookh Sandstone, justifying it thus as a regional feature. In these areas as well as in the syncline 3 km east of Coppin Gap in the Marble Bar Belt. Hickman (1983, p. 1 & 2) did not recognize the unconformity and interpreted volcanics and sediments above the unconformity for the Honeyeater Basalt, which, in the type section of Lippie (1975, Table 1), is below the unconformity. In effect, all these units of the Yarri and northern Port Hedland sheet areas compare well with sections above the unconformity in the Whim Creek Belt, for instance with those of the north flank of the Mt Ada-Mt Wilgie inlier, 15 km south of Roebourne (correctly mapped by Archer, 1979, although this author incorrectly placed these units below the Cleaverville Formation in his legend).

I have since also recognized the unconformity above the Soansville Subgroup in the Coongan Belt, south of Glen Herring, and in the Marble Bar Belt, south of Eginbah. Boulter *et al.* (1987) record its presence in the Tambina complex.



I to XII Lithostratigraphic columnar sections of Figure 3.

Figure 1 Structural units of the northern (exposed) Pilbara Craton (amended after Hickman 1983), and localities mentioned in the text.

In conclusion, the Soansville Subgroup is characterised in parts by the presence of thick units of cherts, chertified sediments, BIFs and shale which have been variously referred to as the Cleaverville Formation (Ryan & Kriewaldt 1964, Hickman 1983), the Paddy Market Formation (Lipple 1975, Hickman & Lipple 1978), and the Gorge Creek Group (Fitton *et al.* 1975, Horwitz 1979). An unconformity, or disconformity, estimated at about 3 Ga years, above the Soansville Subgroup, is recorded nearly everywhere west and north of the Corunna Downs and Mt Edgar Batholiths (Figure 3). An unconformity at a lower stratigraphic level was also noted by Lipple (1975) at the base of the Corboy Formation (the basal unit of the Soansville Subgroup); but this feature was also considered to be of localized extent by Hickman & Lipple (1973, p. 3). An unconformity is however recorded by Krapez (1984) in the Lalla Rookh Syncline and by Wilhelmij & Dunlop (1984) in both the Pilgangoora Syncline and the Strelley area at what these authors consider to be, the base of the Soansville Subgroup equivalent. Figure 3 records most sections where an unconformity or disconformity, basal to the Soansville Subgroup, was observed.

The unconformity of the Kelly Belt

The Kelly Belt passes some 25 km west of Nullagine in the East Pilbara. It flanks the Corunna Downs and Mt Edgar batholiths to the east and southeast. The belt is split in two by a syncline of overlying Mt Bruce Supergroup units (Figs 1 & 2), oblique to the greenstone belt, and the

overlap of these rocks also limits the belt at both ends. The northern part is bound in the southeast by a faulted contact against Warrawoona Group units of the McPhee Dome. Most of the southern half of the belt is on the Marble Bar Geological Sheet area, mapped by Hickman & Lipple (1978), and the northern half is on the Nullagine Geological Sheet area, mapped by R Thom, A H Hickman & R J Chin (in Hickman, 1978). The Kelly Belt was also mapped by Barley (1980).

Noldart & Wyatt (1962, p. 102) recorded a stratigraphic break (in effect an angular unconformity intruded by acid igneous rocks) in the southern half of the belt, between their Budjan Creek Formation and their underlying Warrawoona succession. Many authors have equated this unconformity with the one above the Soansville Subgroup (Lipple, 1975; Fitton *et al.* 1975; Hickman & Lipple, 1978; and Hickman 1983). In the northern part of the Kelly Belt on the Nullagine Sheet area, an angular unconformity is also mapped and Hickman (1983) has attributed it to the same unconformity, namely the one above the Soansville Subgroup and he has named other units in the sequence accordingly.

I examined sections in detail, in the northern part of the Kelly Belt between the Corunna Downs Batholith and the McPhee Dome. Traverses were made along both branches of the upper reaches of Sandy Creek between the Northern Highway and an area about 2 km past the divide into

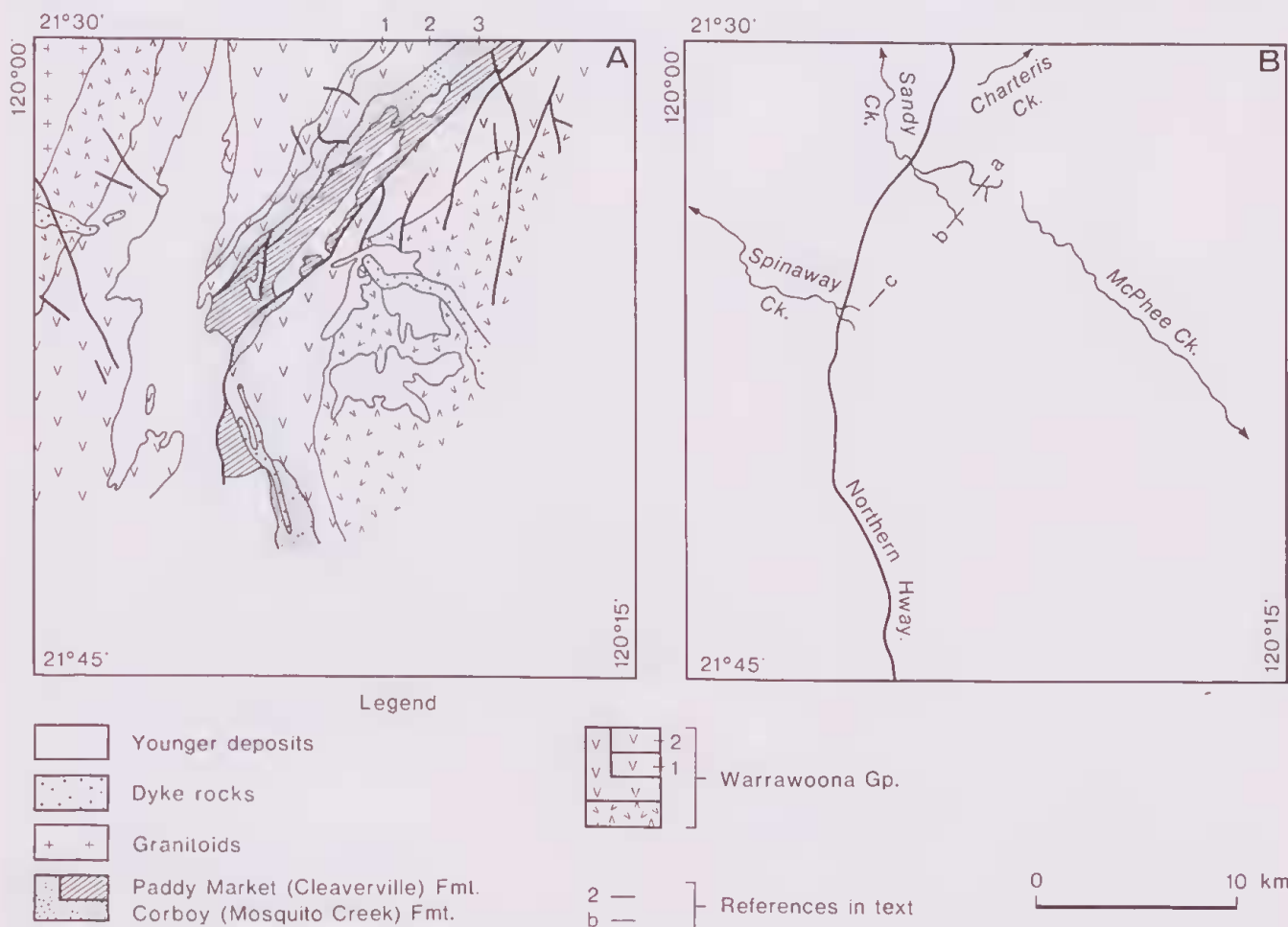


Figure 2 Kelly Belt, Sandy Creek—McPhee Creek area. A Geological map, amended after Thom *et al.* in Hickman (1978). B Map showing sections referred to in the text.

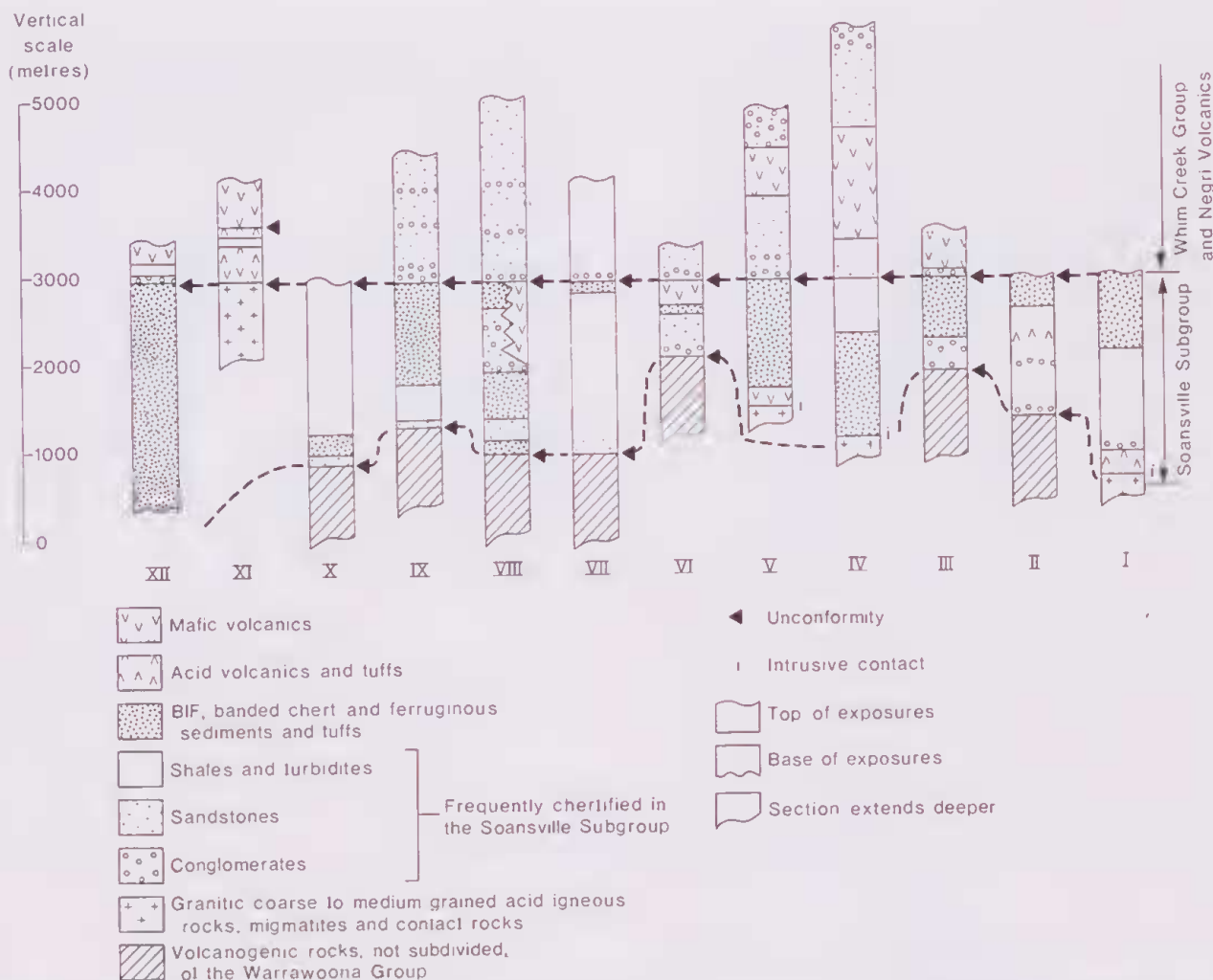


Figure 3 Measured lithostratigraphic columnar sections of selected traverses made in the Soansville Subgroup and adjoining units of the Pilbara Craton. Sills of mafic and acid rocks are not shown. The approximate location of each section is indicated on Figure 1.

- (i) Southern Kelly Belt, north of Spinaway Creek.
- (ii) Northern Kelly Belt, Sandy Creek.
- (iii) Eastern Marble Bar Belt, east of Coppin Gap.
- (iv) Shay Gap Belt, south of Shay Gap township.
- (v) Goldsworthy Belt, south west of Goldsworthy township.
- (vi) Western Marble Bar Belt, south of Eginbah.
- (vii) Northern Coongan Belt, southeast of Glen Herring Pool.

- (viii) Southwestern Lalla Rookh Syncline, Composite section, simplified from Krapez (1984, Fig. 2).
- (ix) Strelley Area, Simplified from Wilhelmij & Dunlop (1984, Fig. 6).
- (x) Mid-northern Soansville Belt. The upper half is derived from Hickman & Lipple (1978, geological map).
- (xi) Eastern Whim Creek Belt, west of Red Hill.
- (xii) Western Whim Creek Belt, south of Roebourne.

the McPhee Creek drainage. A composite lithostratigraphic columnar section is shown in Figure 3. Sections were also examined in the upper reaches of Spinaway Creek (Fig. 2B). In all those areas an unconformity was observed that corresponds to the unconformity mapped by Thom *et al.* (in Hickman, 1978). It is of low angle, on chert or chertified rocks. Basal pebbles, including chert and basalt, occur; the sections along the branches of Sandy Creek are the best exposed.

It is believed that this unconformity does not equate to the younger described (Lalla Rookh Sandstone), above the Soansville Subgroup, but to that basal to the Subgroup (Corboy Formation). The underlying rocks, re-examined in detail as far west as the Northern Highway, are dominantly pillow lavas, alternating with minor bands of chert, vesicular lavas and tuffaceous sediment. All pillows observed indicated younging to the east. The unit, marked (1) on Figure 2A, is believed to have been wrongly chosen by Hickman (1983) as the Corboy Formation equivalent.

It is essentially of bleached pillow lavas, with some chert and chertified tuffaceous sediments at the top, similar to, and with no justification to be excluded from, the underlying Warrawoona Group volcanics, confirming subdivisions and mapping by Barley (1980, 1981). Hickman (*op.cit.*) and Lipple (1975) accordingly named the overlying unit "Charteris Basalt", (Table 1), and it is unfortunate that this area (marked (2) on Fig. 2A), was chosen as the type section for this formation, because basalts do exist in the Soansville Subgroup below the Paddy Market Formation in other areas about 100 km to the west.

The overlying sediments, above the basal conglomerate, in traverses a & b (Fig. 2B) are turbidites and grade from psephytes to pelrites. They contain rare acid volcanics. Discordant chert veins occur (as indicated by Thom *et al.*, and recorded by Hickman 1983, p. 82) as well as large and small olistoliths of chertified sediment. As indicated on the geological sheet the unit grades up (but

with considerable interbedding) into cherts, chertified sediments and BIFs, in relationships, compatible with typical section of the Archaean illustrated by Anhaeusser (1971), and with genetic models described by Eriksson (1983) for BIFs in the Archaean of Southern Africa and Northern Western Australia. In agreement with Thom *et al.* most units were found to be chertified in section c (Fig. 2B).

Wherever observed, the younging persisted to be eastwards, right up to the boundary fault against the Warrawoona Group, thus avoiding the introduction of recumbant overfolds made by Hickman (1973, Fig. 3).

Traverses were later run across the unconformity of the southern part of the Kelly Belt, where a medium grained granitic rock intrudes the sequence in several sills. Our observations indicate that the sedimentary sequence is the same as the one in the north. Indeed, although interrupted, the sequences are of similar rocks and in strike extension along the whole belt, both contain rare acid volcanic rocks, and both show the same relationships to BIFs to the east.

Barley (1981, p. 265) records local unconformities, lower in the sequence, between rhyolite lava flows and basalts. Hickman & Lipple (1976) and Hickman (1983, p. 105) record an unconformity within the Warrawoona Group, at the base of their Duffer Formation. These unconformities in the volcanic piles are not relevant to this discussion.

No younger Archaean sequence, other than the basal unit of the Mt Bruce Supergroup, was recognized anywhere within the Kelly Belt. Some unconformable outliers of conglomerates and breccias, adjacent to fault line scarps, do occur, but they are considered to be associated with the development of the much later Hamersley Landscapes of Twidale *et al.* (1985).

Relationships to the Mosquito Creek area

Relationships of the Soansville Subgroup to the units of the Mosquito Creek area are not yet fully confirmed by field traverses. However, observations in the Brunette Hill general area, to the south of Mosquito Creek, clearly indicate that BIFs are part of the turbidite sequence of the Mosquito Creek Formation of Thom *et al.* (in Hickman 1978). Their mapping around the McPhee Dome indicates that nowhere does the Formation rest upon units comparable to the Paddy Market Formation. The dominance of turbidites in both, the Mosquito Creek Formation and the Soansville Subgroup of the Kelly Belt, argues in favour of their correlation, rather than equating one or the other to the Younger sequences, in which similar facies only occur in the Mallina Trough area some 200 km to the northwest.

The Mosquito Creek Formation, or part of it at least, is thus tentatively assigned to the Soansville Subgroup and unless it is a very complex sequence composed of two unconformable formations, it would appear that the Whim Creek Group, and other young Archaean sequences such as the Lalla Rookh Sandstone, are not preserved, or did not extend, as far east and south as the Kelly Belt.

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